

What Is Claimed Is:

5203, 1. A two-part, room-temperature curable composition having high flash point and low odor, comprising:

- (a) a first component, comprising:
  - (i) an epoxy resin, and
  - (ii) (meth)acrylate component; and
- (b) a second component, comprising:
  - (i) an epoxy resin hardener, and
  - (ii) a catalyst comprising a transition metal complex,

wherein at least one of the first component or the second component, wherein cured reaction products of the composition demonstrate at least substantial maintenance of at least one physical property selected from the group consisting of fixture time, adhesion strength, and adhesion strength over time, after exposure to at least one condition selected from the group consisting of elevated temperatures, moisture and a chemical environment.

2. The composition according to Claim 1, wherein the epoxy resin is a member selected from the group consisting of C<sub>4</sub>-C<sub>28</sub> alkyl glycidyl ethers; C<sub>2</sub>-C<sub>28</sub> alkyl- and alkenyl-glycidyl esters; C<sub>1</sub>-C<sub>28</sub> alkyl-, mono- and poly-phenol glycidyl ethers; polyglycidyl ethers of pyrocatechol, resorcinol, hydroquinone, 4,4'-dihydroxydiphenyl methane, 4,4'-dihydroxy-3,3'-dimethyldiphenyl methane, 4,4'-dihydroxydiphenyl dimethyl methane, 4,4'-dihydroxydiphenyl methyl methane, 4,4'-dihydroxydiphenyl cyclohexane, 4,4'-dihydroxy-3,3'-dimethyldiphenyl propane, 4,4'-dihydroxydiphenyl sulfone, and tris(4-hydroxyphenyl)methane; polyglycidyl ethers of the chlorination and bromination products of the above-mentioned

diphenols; polyglycidyl ethers of novolacs; polyglycidyl ethers of diphenols obtained by esterifying ethers of diphenols obtained by esterifying salts of an aromatic hydrocarboxylic acid with a dihaloalkane or dihalogen dialkyl ether; polyglycidyl ethers of polyphenols obtained by condensing phenols and long-chain halogen paraffins containing at least two halogen atoms; N,N'-diglycidyl-aniline; N,N'-dimethyl-N,N'-diglycidyl-4,4'-diaminodiphenyl methane; N,N,N',N'-tetraglycidyl-4,4'-diaminodiphenyl methane; N,N'-diglycidyl-4-aminophenyl glycidyl ether; N,N,N',N'-tetraglycidyl-1,3-propylene bis-4-aminobenzoate; phenol novolac epoxy resin; cresol novolac epoxy resin sorbitol glycidyl ether; and combinations thereof.

3. The composition according to Claim 1, wherein the epoxy resin includes the combination of bisphenol A-type epoxy resin and sorbitol glycidyl ether.

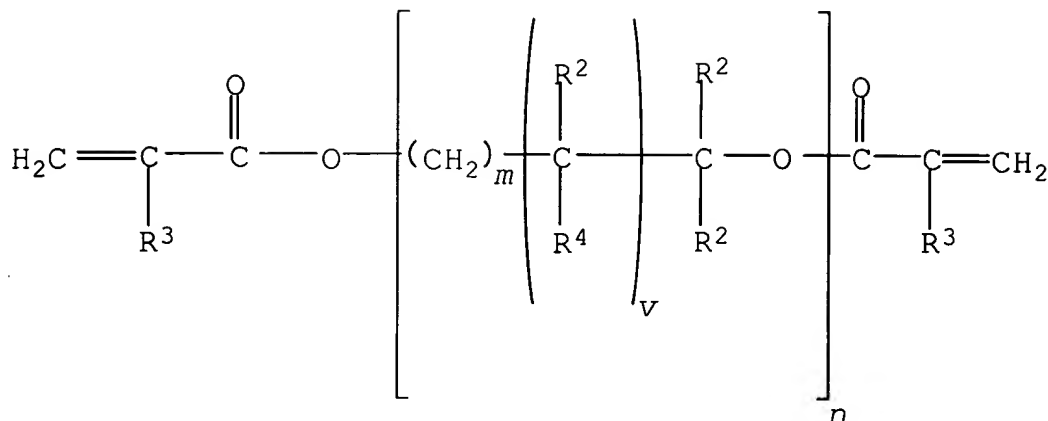
4. The composition according to Claim 1, wherein the epoxy resin is present in an amount within the range of about 5 to about 85 weight percent, based on the total weight of the first component.

5. The composition according to Claim 1, wherein the (meth)acrylate component is a member selected from the group consisting of polyethylene glycol di(meth)acrylates, tetrahydrofuran (meth)acrylates and di(meth)acrylates, hydroxypropyl (meth)acrylate, hexanediol di(meth)acrylate trimethylol propane triacrylate, trimethylol propane tri(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, benzyl (meth)acrylate, dipropylene glycol

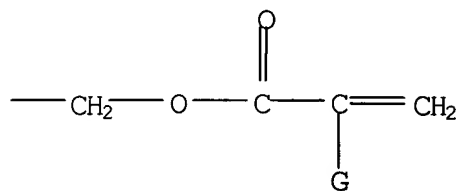
di(meth)acrylate, di-(pentamethylene glycol) di(meth)acrylate, tetraethylene diglycol diacrylate, diglycerol tetra(meth)acrylate, tetramethylene di(meth)acrylate, ethylene di(meth)acrylate, neopentyl glycol diacrylate, and bisphenol-A di(meth)acrylates.

6. The composition according to Claim 1, wherein the (meth)acrylate component is within the structure represented by  $H_2C=CGCO_2R^1$ , wherein G may be hydrogen, halogen or alkyl groups having from 1 to about 4 carbon atoms, and  $R^1$  may be selected from alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkaryl, aralkyl or aryl groups having from 1 to about 16 carbon atoms, any of which may be optionally substituted or interrupted as the case may be with silane, silicon, oxygen, halogen, carbonyl, hydroxyl, ester, carboxylic acid, urea, urethane, carbonate, amine, amide, sulfur, sulfonate, and sulfone.

7. The composition according to Claim 1, wherein the (meth)acrylate component is a member selected from the group consisting of reaction products of diglycidylether of bisphenol A or polyglycols with (meth)acrylic acid forming a (meth)acrylate ester, with the polyglycols of which corresponding to the structure shown below:



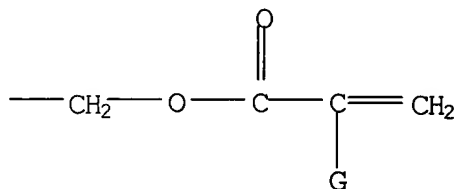
wherein  $\text{R}^2$  may be selected from hydrogen, alkyl groups having from 1 to about 4 carbon atoms, hydroxyalkyl groups having from 1 to about 4 carbon atoms or



wherein G is as defined above;

$\text{R}^3$  may be selected from hydrogen, halogen, and alkyl groups of from 1 to about 4 carbon atoms;

$\text{R}^4$  may be selected from hydrogen, hydroxy and



m is an integer equal to at least 1;

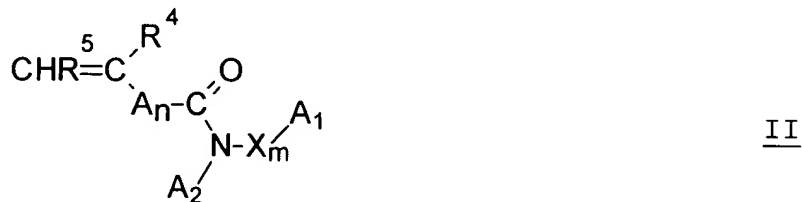
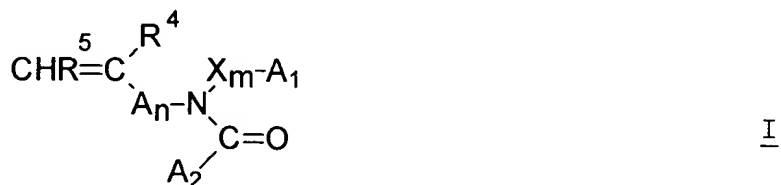
v is 0 or 1; and

n is an integer equal to at least 1.

8. The composition according to Claim 1, further comprising an inorganic and/or organic filler component selected from the group of glass fibers, synthetic fibers, reinforcing silicas, ceramic fiber whiskers, aluminum nitride, boron nitride, zinc oxide, magnesium oxide, aluminum oxide, silicon nitride, silica-coated aluminum nitride, quartz, natural fibers from plant and/or animal sources, and combinations thereof.

9. The composition according to Claim 1, wherein the inorganic and/or organic filler component is present in an amount within the range of about 0.5 to about 35 weight percent, based on the total weight of the epoxy resin component.

10. The composition according to Claim 1, further comprising an adhesion promoter selected from the group consisting of:



wherein R<sup>5</sup> and R<sup>6</sup> may be the same or different and may be selected from hydrogen or C<sub>1-3</sub> alkyl, or either of which may

join to form a cyclic ring structure of between 4 and 10 ring atoms with themselves, or with A<sub>1</sub> or A<sub>2</sub> as defined below;

X and A may be the same or different and may be selected from  $-(CR^7R^8)_p-$ , where R<sup>7</sup> and R<sup>8</sup> may be the same or different and may be selected from

hydrogen or C<sub>1-3</sub> alkyl, and p is an integer of from 0 to 3,

an alkylene group,

an arylene group,

a carbonyl group, -CO-,

heteroatoms, and combinations thereof;

m and n may be the same or different and are 0 or 1; and

A<sub>1</sub> and A<sub>2</sub> may be the same or different and may be selected from hydrogen, C<sub>1-3</sub> alkyl, alkenyl, aryl, aryl heterocyclic, acidic groups, and basic groups.

11. The composition according to Claim 1, wherein the epoxy resin hardener of the second component includes polyether amine-based hardeners selected from the group consisting of oxyethylene diamines, oxyethylene triamines, polyoxyethylene diamines, polyoxyethylene triamines, oxypropylene diamines, oxypropylene triamines, polyoxypropylene diamines, polyoxypropylene triamines, dimethylene glycol dipropyl amine and/or derivatives and adducts thereof, and combinations thereof.

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12. The composition according to Claim 1, wherein the epoxy resin hardener of the second component includes polyether amine-based hardeners selected from the group consisting of JEFFAMINE D-230, JEFFAMINE D-400, JEFFAMINE D-2000, JEFFAMINE T-403, JEFFAMINE ED-600, JEFFAMINE ED-900, JEFFAMINE ED-2001, JEFFAMINE XTJ-504, JEFFAMINE XTJ-509,

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JEFFAMINE T-3000, JEFFAMINE T-5000, 4,7,10 TTD and combinations thereof.

13. The composition according to Claim 1, wherein the transition metal complex is a member within the structure,  $M_e[CW_3-CO-CH=C(O^-)-CW'_3]_2$ , wherein  $M_e$  is a member selected from the group consisting of Fe, Ti, Ru, Co, Ni, Cr, Cu, Mn, Pd, Ag, Rh, Pt, Zr, Hf, Nb, V, and Mo, and W and W' may be the same or different and may be selected from H, and halogens.

14. The composition according to Claim 1, wherein the transition metal complex is a member selected from the group consisting of platinum (II) acetylacetonate, cobalt (II) acetylacetonate, cobalt (III) acetylacetonate, nickel (II) acetylacetonate, iron (II) acetylacetonate, iron (III) acetylacetonate, chromium (II) acetylacetonate, chromium (III) acetylacetonate, manganese (II) acetylacetonate, manganese (III) acetylacetonate and copper (II) acetylacetonate, and carboxylates and/or complexes of any of Fe, Ti, Ru, Co, Ni, Cr, Cu, Mn, Pd, Ag, Rh, Pt, Zr, Hf, Nb, V, and Mo.

15. The composition according to Claim 1, wherein the transition metal complex is Cu(II)ACAC.

16. The composition according to Claim 1, wherein the second component further includes an accelerator.

17. The composition according to Claim 16, wherein the accelerator is selected from the group consisting of nonylphenol, dinonylphenol, piperazine, triethanolamine, water, alcohols, acids and their salts, and combinations thereof.

18. The composition according to Claim 17, wherein the accelerator is present in an amount up to about 50 weight percent, based on the total weight of the epoxy resin hardener second component.

19. The composition according to Claim 1, wherein the first component:second component ratio is in the range of about 1:1 to about 10:1.

20. The composition according to Claim 1, wherein the first component:second component ratio is about 2:1.

21. The composition according to Claim 1, for use in bonding together substrates, at least one of which is constructed of metals selected from the group consisting of steel and aluminum; and synthetics constructed from materials selected from the group consisting of glass cloth phenolics, phenolic composites and plastics.

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22. Reaction products from the composition according to Claim 1.

23. A process for using the composition according to Claim 1 to bond together two substrates, comprising the steps of:

applying the composition onto a surface of a first substrate; and

mating a surface of a second substrate in abutting relationship with the composition-applied first substrate to form an assembly, and maintaining the assembly in the mated



abutting relationship for a time sufficient to allow the composition to cure.

24. A process for using the composition according to Claim 1 to bond together two substrates, comprising the steps of:

applying the composition onto a surface of at least one of a first substrate or a second substrate, and maintaining each of the composition-applied substrate(s) away from the other substrate for a time sufficient to allow the composition to cure somewhat; and

mating the substrates in abutting relationship to form an assembly.

25. A process for using the composition according to Claim 1 to bond together two substrates, comprising the steps of:

mating in spaced-apart relationship a first substrate with a second substrate; and

applying within the space the composition and maintaining in an assembly the first substrate and the second substrate for a time sufficient to allow the composition to cure.

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